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*ON AVOIDANCE BEHAVIOR IN RATS: PERSISTENCE OF
FEAR FOLLOWING REDUCED INSTRUMENTAL RESPONDING*

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THE EFFECTS OF RESPONSE PREVENTION
ON AVOIDANCE BEHAVIOR IN RATS:
PERSISTENCE OF FEAR FOLLOWING REDUCED
INSTRUMENTAL RESPONDING

by



ARTHUR GORDON

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
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DEPARTMENT OF PSYCHOLOGY

EDMONTON, ALBERTA

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THE UNIVERSITY OF ALBERTA
FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "The Effects of Response Prevention on Avoidance Behavior in Rats: Persistence of Fear Following Reduced Instrumental Responding", submitted by Arthur Gordon in partial fulfillment of the requirements for the degree of Master of Science.

Paul F. Zelch
Supervisor

J. J. Jones ext
R. C. Walley

August 21, 1973
Date

DEDICATION

Dedicated to my parents
for their love and understanding

ABSTRACT

The current research was designed to determine the effects of response prevention on instrumental avoidance behavior and conditioned fear. Fear elicited by the avoidance CS was indexed according to the disruption in ongoing operant behavior observed upon presentation of the CS.

The experiment consisted of four phases. In the first, all SS were trained to a common criterion of acquisition in a two-way avoidance task. In phase 2, subjects received either 0, 3 or 9 trials of response prevention. This treatment consisted of presenting the avoidance CS while the learned avoidance response was prevented. In the third phase, SS in each response prevention condition either received, or did not receive, extinction training. Finally, all SS were tested for conditioned fear in a separate Skinner box.

Three major findings were reported. Firstly, response prevention led to the rapid elimination of the avoidance response. However, greater post-extinction levels of conditioned fear were observed when a period of response prevention preceded extinction trials. Finally, when extinction trials were not permitted, response prevention did not reduce fear below the level present at the end of

acquisition training.

These results demonstrate that response prevention tends to reduce instrumental responding without necessarily affecting a similar reduction in conditioned fear. The results are interpreted in terms of competing response theory which postulates the acquisition, during response prevention, of a new response, incompatible with the original avoidance response. Further discussion is focused upon the concept of species specific defense reactions as providing the mechanism by which the competing response may be acquired. Finally, the implications of these results for implosive therapy are considered, and it is concluded that the response prevention paradigm may not be appropriate for investigating the processes involved in the human therapeutic situation.

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INTRODUCTION

The issues involved in avoidance behavior have traditionally attracted attention from both experimentally and clinically oriented researchers. A repeated finding in the animal literature has been that the learned avoidance response tends to be highly resistant to extinction (Solomon, Kamin and Wynne, 1953; Sidman, 1955; Shearman, 1970), despite the fact that the animal is not exposed to the aversive UCS after conditioning. As such avoidance behavior appears similar in many respects to that found in human phobias, determination of techniques that facilitate the extinction of avoidance behavior are of both theoretical and clinical importance. Several such procedures have been developed in both the experimental and clinical settings.

One of the most effective of these techniques has been variously labelled "blocking" (Page and Hall, 1953), "detainment" (Weinberger, 1965), or "response prevention" (Baum, 1966). Administered following acquisition of the avoidance response, response prevention consists of forcing the animal to remain in the presence of the feared stimulus, while all avoidance responses are prevented. Although there have been some reports of very limited (Solomon et. al., 1953) or transient (Benline and Simmel, 1967) success with

this procedure, a more common finding is that the avoidance response tends to undergo rapid extinction following a period of response prevention (Page and Hall, 1953; Black, 1958; Weinberger, 1965; Baum, 1966).

With human subjects, a behavior therapy technique called implosive therapy has been developed to eliminate phobic avoidance behavior (Stampfl and Levis, 1967, 1968). Here, the patient is required to visualize extreme anxiety arousing stimuli related to the phobia. As no aversive consequences follow, it is assumed that these stimuli lose their anxiety provoking powers, thus leading to elimination of the avoidance behavior. Despite obvious interspecies differences in administration of the aversive stimuli, response prevention is generally considered to be the subhuman analogue of implosion (Baum, 1970; Morganstern, 1973).

Although both techniques claim to eliminate fear or anxiety in addition to altering avoidance behavior, recent evidence has suggested that fear reduction may not always be the result. Rachman (1969) has argued that implosion may serve to exacerbate rather than reduce anxiety. In fact, Wolpe (1969) has reported clinical evidence of such an effect. Similarly in the case of response prevention, several studies have found that while avoidance responding

is rapidly eliminated, fear remains relatively undiminished (Page, 1955; Coulter, Riccio and Page, 1969; Linton, Riccio, Rohrbach and Page, 1970).

These findings have also proven to be embarrassing for Mowrer's (1947) two-process theory of avoidance behavior which cannot account for residual fear following instrumental extinction. Since two-process theory has provided the most widely accepted account of both implosion (Morganstern, 1973) and response prevention (Baum, 1970), the inability of two-process theory to account for these findings has given rise to new questions concerning the processes by which these techniques produce their effects.

The present thesis is primarily concerned with the effects of response prevention on fear. In addition to considering the two-process position on this issue, reference will be made to two other theoretical models which have attempted to account for residual fear following a response prevention treatment. The first of these, competing response theory, (Page, 1955), maintains that a new avoidance response, also motivated by fear, is acquired during response prevention. In this case, fear is expected to be maintained at its post acquisition level. The second theory, incubation theory (Eysenck, 1968), describes a process by which unreinforced presentations of the avoidance

CS during response prevention may enhance the level of fear. Finally, consideration will be given to the response prevention procedure itself as a factor influencing conditioned fear.

The Nature of Fear

Before considering the theoretical issues related to extinction of avoidance behavior and fear, a closer examination of the concept of "fear" may be helpful. Although this concept has traditionally been invoked to explain avoidance behavior, little attention has been paid to its precise definition. Rather, fear has typically been understood to represent the state of being "afraid". While some authors (Solomon and Wynne, 1954) have considered fear to be one component of the unconditioned reaction to pain, fear is more typically viewed as a conditioned response to a previously neutral stimulus (Mowrer, 1947, 1960; Bolles, 1967). That is, if a CS is paired with an aversive stimulus such as shock, the CS will come to elicit a "fear" response. Mowrer (1947) argued that this response involved strictly autonomic processes. More commonly however, the fear response is seen to be more complex, involving "reactions of the autonomic nervous system which result in visceral responses of high magnitude, skeletal motor discharge,

neuroendocrine responses and activity of the higher central nervous system" (Kimble, 1961, p. 269).

On the basis of these definitions, the measurement of fear would appear to necessitate indexing the concurrent physiological (ie. heart rate, skin conductance), and behavioral (defecation, freezing) manifestations of the fear response. However, little attempt has been made to quantitatively relate fear to its eliciting conditions. Rather, the occurrence of fear is typically assumed from the same behavior it is required to explain. For example, the presence of a fear reaction, which has been assumed to be necessary to motivate avoidance behavior (Mowrer, 1947), is often inferred from the occurrence of the avoidance response itself (Benline and Simmel, 1967). Some studies, employing an avoidance paradigm, have attempted to validate the inferred presence of fear by measuring heart rate changes to the avoidance CS (Black, 1959; Soltysik, 1960). However as Black (1959) has noted, factors other than the conditioning treatments (ie. skeletal activity, respiration) may have a profound effect on heart rate. Particularly in an active avoidance paradigm, heart rate changes reflecting fear may be confounded with changes reflecting motor activity. The difficulties involved in recording and interpreting such autonomic data, has encouraged the adoption of more indirect

methods of measuring conditioned fear.

A more common approach to this problem, has been to indirectly measure fear by assessing other behaviors which are believed to sensitively reflect conditioned emotionality. For example, D'amato (1970) has described fear as a fractional anticipatory pain response which leads to avoidance of the eliciting CS. It follows that latency to approach a CS should reflect its fear eliciting properties. Page (1955) has adopted this conclusion in proposing what shall here be labelled, a "reentry" test of fear. This test involves returning the food deprived S to the "safety" compartment of the avoidance apparatus at some time following the training procedures. At this time, S is allowed free entry to the "shock" compartment where food is available in the presence of the CS. Thus, S is motivated to approach the food while fear elicited by the CS tends to inhibit this approach. Latency to enter the compartment, or to consume food, is taken as a quantitative measure of CS elicited fear, greater latencies indicating a stronger conditioned fear response.

An alternative test of fear is provided by the conditioned suppression technique first suggested by Estes and Skinner (1941). In this study, the authors found that a CS previously associated with shock led to the suppression

of operant bar press behavior when it was superimposed on the ongoing responding. This effect was assumed to be due to fear elicited by the CS being reflected in freezing behavior which was incompatible with the operant response. More recent evidence has provided confirmation for this interpretation by showing that freezing tends to be an unlearned manifestation of fear (Blanchard and Blanchard, 1969; Bolles, 1970). Therefore, to the extent that a CS is capable of disrupting such ongoing operant behavior, it may be said to have fear eliciting properties.

The discussion to this point has centered primarily on the definition and measurement of fear as a response to a CS. In considering the concept of fear, it should be noted that fear has also been viewed as both a stimulus (Miller, 1951) and as an acquired drive (Miller, 1951; Bolles, 1967). In its latter role, fear is seen to motivate responding (ie. avoidance responding), with fear reduction acting as a reinforcing event for the response. Although the drive properties of fear assume a crucial role in the theories of avoidance behavior to be considered momentarily, measurement of fear in the present thesis will be restricted to the response characteristics of fear as described above.

Two-Process Theory

Two-process theory (Mowrer, 1947; Rescorla and Solomon, 1967) postulates conditioned autonomic responses as the basis for both the acquisition and maintenance of avoidance responding. Early trials of avoidance training serve to provide CS-shock pairings which facilitate the establishment of a fear reaction (CR) to the CS. Sensory feedback from the fear CR is then believed to instigate the instrumental avoidance response. This response serves to terminate the CS which in turn leads to a reduction in fear. Reduced sensory feedback from the fear CR is seen to act as a reinforcing event for the avoidance response. More simply, avoidance responding is motivated by a conditioned fear reaction, and reinforced by fear reduction. It follows from this that the fear CR is necessary for the maintenance of the instrumental response (Solomon *et. al.*, 1953).

Whenever the CS occurs in the absence of the US, the fear CR suffers a decrement in strength through Pavlovian extinction. As the US is never present during extinction training, CR (fear) strength is gradually reduced to a level insufficient to instigate behavior, nor can its further reduction act to reinforce behavior. Both response prevention and implosion are seen to facilitate extinction by enforcing prolonged exposure to the CS in the absence of

the US, thereby accelerating the rate of decay of CR strength.

It is clear that several relations between conditioned fear and instrumental responding are required by two-process theory (Rescorla and Solomon, 1967). Of particular importance here is the requirement that extinction of the avoidance response occur concurrently with, or closely follow, extinction of the fear reaction. Accordingly, the theory should predict that both fear and avoidance responding should be rapidly eliminated following response prevention. The theory could not apparently account for the existence of CS elicited fear following instrumental extinction. This would be true whether or not a period of response prevention was introduced prior to extinction training, as instrumental extinction is considered to be a sufficient indicator of the elimination of conditioned fear.

Before examining the effects of response prevention on fear, brief consideration will be given to the relationship between fear and regular extinction. (The term "regular extinction" as used here, refers to extinction training which is not preceded by a period of response prevention). Studies which have examined this relationship by monitoring fear over the course of extinction training have tended to be rather inconsistent in their findings. Both Black (1959)

and Soltysik (1960) measured heart rate changes to the CS as an index of fear. While Black (1959) found more rapid extinction of the conditioned fear response than of the avoidance response, Soltysik (1960) reported parallel extinction of the two responses. Kamin, Brimer and Black (1963) used a conditioned suppression test to monitor fear after various criteria of extinction had been attained. Although fear in this case did show a monotonic decline over extinction trials, considerable suppression was observed even following attainment of a fairly severe criterion of extinction, indicating substantial levels of residual fear.

Equally inconsistent are the results of studies measuring fear following the attainment of a set criterion of extinction. Several studies (Page, 1955; Coulter et. al., 1969; Linton et. al., 1970) have measured fear according to the reentry test described earlier. In these studies, animals receiving both acquisition and extinction training were compared with a group having had no experience with shock in the test apparatus. This latter group served to provide a no fear baseline condition. Based on the results of these experiments, there would seem to be evidence to suggest that fear both does (Page, 1955), and does not (Coulter et. al., 1969; Linton et. al., 1970) exist following instrumental extinction. Using a different

measuring technique, Baum (1971) has also observed post-extinction fear. Following extinction training, a loud buzzer was presented in combination with the avoidance CS. Recovery of avoidance responding at this stage was taken as an index of residual, or unextinguished, fear. Although, as Baum concludes, methodological differences in the measurement of fear may account for some of these discrepant results, the evidence would seem to indicate a considerable lack of parallelism between fear and instrumental responding. In particular, elimination of the avoidance response may not necessarily indicate extinction of fear. These findings pose a definite problem for a two-process interpretation of avoidance extinction.

Also puzzling for the theory are the findings related to the effects of response prevention on conditioned fear. Page and his associates (Page, 1955; Coulter, Riccio and Page, 1969; Linton, Riccio, Rohrbaugh and Page, 1970) have reported a series of experiments relevant to this issue. The paradigm employed by Page (1955) will be described here in some detail as it is typical of most experiments employing a response prevention paradigm. Following acquisition of a one way avoidance task, ss in Page's study were assigned to one of two extinction conditions. For the regular extinction group, trials were continued as per acquisition training

with the exception that no shock was present at any time. The second group experienced five trials of response prevention prior to receiving regular extinction trials. Response prevention trials consisted of presenting the CS in the absence of shock while the barrier separating the two compartments of the avoidance apparatus remained raised. Thus S was forced to remain in the presence of the CS as the learned avoidance response was prevented.

Twenty-four hours following the attainment of the extinction criterion, S was returned to the "safe" compartment of the apparatus to begin the reentry test for fear. The results indicated that the response prevention animals both completed fewer trials to extinction, and exhibited significantly greater reentry latencies than did the regular extinction SS. Using the same basic paradigm, both Coulter et. al. (1969) and Linton et. al. (1970) have replicated this finding. As both response prevention and control groups in these studies were trained to the same criterion of extinction, two-process theory would have predicted equal levels of residual fear. Further, with sufficient extinction training, fear should have been fully extinguished. In both the Coulter et. al. and Linton et. al. studies, fear in the regular extinction group did appear to be eliminated as the reentry latencies for these animals did

not differ from those of unshocked control ss. This suggests that response prevention did not produce its effect by merely accelerating the normal extinction process. Further, the model of extinction postulated by two-process theory would seem to be inadequate to account for the effects of response prevention in these studies.

Competing Response Theory

Recently, Page (1955; Coulter, Riccio and Page, 1969) have attempted to reconcile the findings of residual fear with two-process theory, by postulating the acquisition, during response prevention, of a new avoidance response motivated by fear. This competing response theory is, in fact, a special case of traditional two-process theory applied to the response prevention paradigm. According to two-process theory, CS onset in an avoidance paradigm results in a fear reaction which is reduced by CS offset. During response prevention, any response which immediately preceeds CS termination will therefore be adventitiously reinforced. As the learned active avoidance response is blocked during response prevention, S will most likely be reinforced for non-locomotory responses (ie. freezing, crouching). During extinction, S may emit this new response in the presence of the CS, resulting in rapid extinction of

the original avoidance response. In this case, fear would not be expected to undergo extinction, but rather would be motivating a new instrumental response. In fact, fear would be expected to remain undiminished over the course of response prevention (Coulter *et. al.*, 1969).

Empirical testing of this model has been directed towards establishing the relationship between response prevention and fear. That is, the theory should predict greater post-extinction levels of fear in subjects receiving response prevention training. Further, the level of fear measured following attainment of the acquisition criterion should not differ from that level measured following response prevention. Experiments answering to the first prediction have tended to be rather inconsistent in their findings, perhaps owing to the designs and fear indices employed. Following extinction, Baum (1971) administered additional trials in which the CS was paired with a loud buzzer. Recovery of responding was taken to reflect unextinguished fear mobilized by the buzzer. Contrary to competing response expectations, equal recovery was found in both response prevention and regular extinction animals. However, as no group received CS trials in the absence of the buzzer, responding may have reflected spontaneous recovery in the test situation. Based on a heart rate index,

Black (1959) has also reported equal levels of fear following extinction of a panel press avoidance response. As was noted earlier however, heart rate changes may not accurately reflect conditioned fear in an active avoidance paradigm (Rescorla and Solomon, 1967) . A similar criticism may be raised against a study by Werboff, Duane and Cohen (1964) . Using a shuttlebox avoidance task, Werboff et. al. found greatly elevated heart rates in response prevention animals long after these animals had ceased responding on the avoidance task. It seems possible that this effect may have been due to increased motor activity (ie. exploratory behavior) following instrumental extinction. Benline and Simmel (1967) have also concluded that fear in response prevention subjects is enhanced following extended extinction training. Unfortunately, fear in this study was inferred from the subject's avoidance behavior during extinction, a measure which does not necessarily reflect conditioned fear (Kamin et. al., 1963) .

From the above findings. it is not clear that residual fear remains undiminished following response prevention. The previously discussed findings of Page (1955) and Coulter, Riccio and Page (1969) would seem to offer the strongest support for competing response theory on this point. It will be recalled that both of these studies showed that subjects

receiving response prevention trials both extinguished more rapidly, and exhibited greater residual fear, than subjects receiving regular extinction training. However, it seems possible that these results may be explained without necessarily postulating the acquisition of a competing response motivated by fear. There is evidence to suggest that the strength of fear is an inverse function of the amount of non-reinforced CS exposure, irrespective of the subject's instrumental behavior (Brimer and Kamin, 1963; Kamin et. al., 1963). In Page's studies, response prevention SS received far less CS exposure by virtue of their reduced responding in extinction. Reduced CS exposure may therefore account for the reported findings of enhanced levels of fear.

Wilson (1973) controlled for CS exposure by administering a fixed number of extinction trials to all groups. According to a reentry test, response prevention animals exhibited less residual fear than regularly extinguished controls. However, unlike Page's experiments, subjects in Wilson's study did not all attain a similar level of instrumental responding prior to the fear test. While response prevention animals had ceased responding long before the test, most control subjects were still responding to the CS on almost all trials. Shipley, Mock and Levis

(1971) avoided this problem by measuring fear prior to extinction training. If fear is maintained during response prevention, the level of fear following acquisition should not differ from that following response prevention. On the other hand, if fear is reduced as a function of CS exposure, post-acquisition levels of fear should be greater than those following the treatment. Operating within this framework, both Shipley *et. al.* (1971) and Bersh and Paynter (1972) have shown that fear is reduced as a function of CS exposure during response prevention.

It is difficult to see how competing response theory can account for these findings. As fear is considered necessary for the maintenance of the competing response, and as the strength of the response should increase with additional CS terminations, fear should remain undiminished throughout response prevention. It is important to note however, that while the studies cited above have claimed to be replicating Coulter *et. al.*'s (1969) procedure, all have failed to replicate one important procedural parameter; namely, the relative CS exposure duration during response prevention. While Coulter *et. al.* used a CS duration equal to the CS-US interval, all other studies have employed CS durations which greatly exceed this interval. It shall be argued here that this methodological difference may account

for the failure to observe maintained levels of fear.

Response Prevention - Methodological Considerations

Before considering how the application of response prevention might in itself influence fear, it may be helpful to elaborate on the process by which a competing response may be acquired. Unlike normal avoidance acquisition, the competing response is learned in the absence of a noxious US. That is, fear previously established to the CS motivates a new response which serves to terminate the CS, thereby removing S from the fearful situation. A good illustration of this acquisition process has been provided by Miller (1948). Here, rats were shocked in a white compartment (the CS) and allowed to escape to a black compartment. Subsequently, when the original running response was blocked, the animals acquired new instrumental responses (ie. bar pressing, wheel turning) in order to leave the white compartment. These responses were learned despite the fact that shock was never present during this phase of the experiment. The acquisition process in this case closely resembles that proposed by competing response theory with one major exception. Whereas the animals in Miller's (1948) study were able to instrumentally control CS duration, CS duration during response prevention is solely under the

control of E, and is therefore response independent. However in this latter case it may be argued that subjects may superstitiously learn that their behavior (ie. freezing) appears to control CS termination. The position taken here is that this superstitious learning may be facilitated or inhibited, depending in part on the nature of the CS presentations during response prevention.

If a competing response is to be learned, the CS must be capable of eliciting a fear reaction. Fear is necessary both to motivate the new response, as well to reinforce responding through fear reduction. Miller (1951) has reviewed evidence which suggests that in the absence of the US, a new avoidance response will not be acquired unless the CS is capable of eliciting a fairly high level of fear. It follows that reducing the level of CS elicited fear should reduce the probability of a new response being learned. One way of reducing fear, is to change the CS itself. According to a generalization decrement hypothesis (Kimble, 1961), changes in a stimulus controlling a response leads to a weakening of that response. In the present case, the CS comes to control fear during avoidance acquisition. Altering the CS during response prevention should lead to a reduced fear reaction, and thus to the inhibition of development of a competing response.

One property of the CS which is typically altered during response prevention trials is the duration of CS exposure. Based on studies employing an inhibition of delay paradigm (Rescorla and Solomon, 1967), it seems likely that the fear response may come under the control of both physical and temporal components of the CS. In the case of avoidance behavior, the CS-US interval may therefore come to elicit, in part, the conditioned fear response. Based on the behavior of their animals, Solomon, Kamin and Wynne (1953) have concluded that long latency avoidance responses (ie. approaching end of CS-US interval) are associated with greater fear elicitation than short latency responses. This suggests that the duration of the CS is a discriminable stimulus affecting conditioned fear. It follows that extending the duration of the CS during response prevention may alter the stimulus properties of the CS, resulting in a reduced fear response. This may reflect itself at the time of fear testing and may account for the findings of reduced fear reported earlier (ie. Shipley et. al., 1971; Bersh and Paynter, 1972). Further, fear would be expected to be reduced to the extent that the CS has been altered. Baum (1971) used a CS-US interval of 10 seconds during acquisition but presented a single response prevention trial of 20 minutes duration. Fear testing indicated very little

unextinguished fear.

Although this analysis may account for the reported results, an equally plausible account of the effects of response prevention on fear is offered by the previously discussed notion that fear is solely an inverse function of total CS exposure (Shipley et. al., 1971). These alternatives may perhaps be differentiated by varying the number of response prevention trials while holding CS exposure on each trial equal to the CS-US interval. If fear reduction is dependent on total CS exposure, it should show a monotonic decline with increased response prevention trials. If however, fear serves to motivate a competing response, it should not be reduced from its post acquisition level. The present experiment was designed, in part, to test these alternatives. In order to eliminate the confounding effects of CS exposure during extinction training (Shipley et. al., 1971), an optimal procedure would appear to involve measuring fear immediately following response prevention. In this case, groups would differ only by the amount of CS exposure administered by E during the response prevention treatment.

Incubation Theory

The present design may also have implications for the incubation theory of anxiety proposed by Eysenck (1968). This theory claims that brief, unreinforced presentations of an aversive CS may exacerbate fear rather than reduce it. Briefly, Eysenck considers the elicited fear CR to be, in itself, aversive to the organism. If the fear CR is sufficiently strong, it may act as a noxious stimulus to reinforce and strengthen the existing fear response. If the elicited CR is weak, Eysenck argues that it undergoes Pavlovian extinction in the presence of the CS. Thus, according to the theory, the strength of the original fear CR is an important determinant of the occurrence of incubation of fear.

From the previous discussion of the effects of CS duration on conditioned fear, it would be expected that relatively brief CS exposures (ie. no greater than the CS-US interval) should facilitate such an incubation effect. The previously cited study by Solomon *et. al.* (1953) provides some support for this conclusion. Here, long latency avoidance responses were found to be typically followed by very short latency responses. The authors concluded that this effect was due to an increase in the elicited fear on long latency trials which served to increase the

motivational component of the avoidance response on the following trial. Rohrbaugh and Riccio (1970) have also reported evidence supporting the possibility of an incubation effect. Following a series of classical fear conditioning trials, subjects received a single trial during which the CS was presented in the absence of shock. The duration of CS exposure on this trial varied from 0 seconds (no exposure) to 20 minutes. A subsequent reentry test for fear indicated that subjects receiving brief exposures to the CS (30 seconds) exhibited greater fear than either no exposure or long exposure groups. If, as these studies suggest, brief CS presentations may increase fear, response prevention subjects in the present experiment may show greater fear than those Ss tested immediately following acquisition training. Clearly, any increase would be incompatible with the hypothesis that fear is simply an inverse function of CS exposure.

Indices of Fear

One last issue which must be considered is the means by which the conditioned fear response is to be measured. With very few exceptions, (ie. Baum, 1971), most studies employing a response prevention paradigm have indexed fear according to the previously described reentry test (Page,

1955). Briefly, this test is arranged as an approach-avoidance situation whereby S is motivated to approach the CS to receive food, while fear elicited by the CS inhibits this approach behavior. The degree to which S passively avoids the CS is taken as a measure of CS elicited fear. This procedure, especially as employed by Page (1955) and Coulter et. al. (1969), would seem to be marked by several methodological weaknesses. In these studies, food deprivation was first introduced following completion of the avoidance procedures, resulting in the S being trained and tested under different drive states. Shipley et. al. (1971) have argued that such a deprivation procedure may have differentially altered the internal cues of the various experimental groups prior to fear testing. There is also a question as to whether the animals were truly motivated to consume food under these deprivation conditions. There is considerable evidence to suggest that merely depriving an animal for a single 24 hour period does not insure that food will be consumed when made available (cf. Kling and Riggs, 1971, pp. 817-820). Again, the motivation to consume food after 24 hours of deprivation may have been differentially affected by the various treatment conditions in the avoidance situation.

While these methodological weaknesses do not

necessarily negate the results reported by Page and Coulter *et. al.*, they do suggest the desirability of a replication of their results using a more controlled test of fear. A replication would be especially desirable as these two studies have provided the empirical basis and the strongest support for competing response theory. Indeed it is not clear that post extinction fear is in fact greater following a response prevention treatment (Black, 1955; Baum, 1971). Baum (1971), after failing to replicate Coulter *et. al.*'s findings, has correctly concluded that no general statements about avoidance behavior can safely be made on the basis of only a single measuring technique. The present experiment used a conditioned suppression index of fear (Estes and Skinner, 1941; Kamin *et. al.*, 1963) to test the hypothesis that response prevention leads to enhanced levels of residual fear when compared with a regular extinction procedure.

It will be recalled that the conditioned suppression test involves superimposing the avoidance CS on ongoing, appetitively motivated, operant behavior. Suppression of this behavior in the presence of the CS is then taken as a measure of the fear elicited by the CS. Although this technique has been employed in studies monitoring fear during avoidance acquisition and extinction (Hoffman and

Fleshler, 1962; Brimer and Kamin, 1963; Kamin et. al., 1963), it has thus far not been incorporated into a response prevention paradigm. It offers the advantage of providing a highly quantitative, continuous monitoring of the subject's behavior, and seems to provide a fairly sensitive index of conditioned fear (Kamin et. al., 1963). Further, as the test is carried out in an environment other than the avoidance apparatus, responses elicited by the CS are not confounded by those elicited by situational cues in the training environment. Finally, it provides an alternative to the reentry test, thus allowing for an independent test of competing response predictions.

Experimental Design and Hypotheses

The purpose of the present experiment was to determine the effects of various levels of response prevention on fear. A 2x3 factorial design was employed with extinction training and response prevention as the variables. Following acquisition of a two-way shuttlebox avoidance task, Ss received either 0, 3 or 9 trials of response prevention (conditions RP(0), RP(3) and RP(9) respectively). Each trial involved presenting the CS for 10 seconds (the CS-US interval) while S was confined to one compartment of the apparatus. Upon completion of the prescribed number of

trials, one half of the subjects in each response prevention condition received extinction training (condition E) during which S was free to respond to the CS. For these animals, fear testing immediately followed attainment of a set criterion of extinction. The remaining animals did not receive extinction training (condition NE), but were tested for fear immediately following completion of the response prevention trials. Six experimental groups of 5 animals were thus defined according to the response prevention and extinction conditions to which they were assigned. For example, Group RP(3)-NE received 3 trials of response prevention followed by the conditioned suppression test, while Group RP(3)-E had a period of extinction training interspersed between response prevention trials and the test for fear.

Two major hypotheses were tested by the present experiment. The first dealt with the effects of response prevention while controlling for CS exposure. If Page is correct and fear is maintained throughout response prevention, then equal levels of fear should be exhibited by Groups RP(0)-NE, RP(3)-NE and RP(9)-NE. If however, fear is reduced as a function of total CS exposure, then Group RP(0)-NE should exhibit greater fear than Group RP(9)-NE as this latter would have received 9 additional trials of CS

exposure. In this case, fear in Group RP(3)-NE Ss should be at some level between the other two groups. Finally, if either of Groups RP(3)-NE or RP(9)-NE exhibited greater fear than Group RP(0)-NE, support would be provided for Eysenck's incubation theory

The present design also allows for the testing of the hypothesis that response prevention leads to greater levels of post extinction fear. This competing response prediction would be supported by a finding of greater fear in Groups RP(3)-E and RP(9)-E than in Group RP(0)-E. Equal levels of fear across these three groups would support the findings of Baum (1971), and would cast doubt on competing response theory.

Method

Subjects

The experimental SS were 71 male albino rats obtained from the breeding facilities at the University of Alberta. All SS were individually housed, and were maintained on 23 hour water deprivation and ad libitum feeding schedules throughout the experiment. At the time of avoidance training, the animals weighed 300-400 gms.

Apparatus

Bar press training and fear testing were carried out in a Lehigh Valley, single bar operant conditioning unit, which was placed in a sound attenuating ice chest. Scheduling of reinforcement, recording of bar press data, and presentation of stimuli were all controlled by BRS programming modules located in a separate control room. The operant unit was equipped with an exhaust fan which provided a constant background noise level of 67 ± 1 db. In addition, background illumination of 0.3 foot-candles was provided by a red-covered light source. Three identical chambers were used during the course of the experiment.

Two discrete stimuli were introduced into the apparatus

at various stages of the procedure. The first, a white noise, was presented through a 4" speaker mounted on the inside wall of the ice chest and served to raise the sound level to 70 ± 1 db. The second stimulus, a house light, was a clear bulb mounted next to the speaker which increased illumination in the chamber to 3.2 foot-candles.

All avoidance procedures were conducted in a two-way shuttlebox, each compartment of which measuring 9.5in. long x 6in. wide x 7in. high. The compartments were separated by a clear plexiglas barrier which rose 2.5 inches above the grid floor. During response prevention, this barrier was raised and latched at the ceiling of the apparatus in order to block passage between the two compartments. The walls of the apparatus were clear plexiglas covered by sheets of opaque brown paper. Observation of S's behavior was made possible by a mirror suspended above the plexiglas ceiling.

Stainless steel grids spaced $1/2$ inch apart formed the floor of each chamber. Shock from an Applegate shock source (model 228) could be selectively delivered to either of the two compartments at an intensity of 0.6mA. Trials were automatically terminated by the S interrupting a photocell located $5 \frac{1}{2}$ inches from the end wall of each compartment. Both the CS-US interval and the occurrence of shock were programmed through a series of Hunter timers, while the

initiation of each trial and recording of all data was controlled by E.

The avoidance CS was white noise generated from the same source as that used in the operant chambers. In this case, an exhaust fan located immediately behind the apparatus maintained a background noise level of 65 ± 1 db, while introduction of the white noise raised this level to 72 ± 1 db. A 7.5W bulb, also located behind the apparatus, provided the only light source with an intensity of 0.2 foot-candles at the centre of the apparatus.

Procedure

Operant Training. Following an initial 3 days of 23 hour water deprivation, all Ss were trained to bar press for water reinforcement. This training concluded with a minimum of 4 days of VI90 second responding in order to insure stable operant behavior. The last day of operant training also served as a stimulus habituation session. This was necessary to insure that the test stimuli did not produce reliable suppression of behavior prior to the avoidance procedures. This session began with a 20 minute warmup period during which no stimulus presentations were programmed. Following the warmup, the white noise was introduced on 6 occasions, each of 20 seconds duration. On

each trial, the number of bar presses during the CS, as well as during the 20 second period immediately preceeding CS onset, were automatically recorded.

It was hypothesized that the avoidance procedures might serve to sensitize S to stimulus changes in the environment, resulting in spurious suppression of behavior in the presence of the white noise. In order to control for such an effect, a neutral stimulus (the house light) was introduced on some trials in a manner identical to that for the white noise. The order of presentation of the two stimuli was as follows (white noise-WN; house light-HL); HL,WN,WN,HL,WN,HL,WN,HL,WN,HL,WN,HL, yielding six presentations of each stimulus. The interval between presentations was approximately 4 minutes. It should be noted that the ongoing reinforcement schedule was programmed independently of the stimulus presentations. Thus, it is unlikely that either stimulus came to elicit suppression by reliably predicting the absence of reinforcement.

Avoidance Acquisition. Twenty-four hours following the habituation session, subjects were trained in the avoidance task. In order to facilitate acquisition, Ss were allowed to habituate to the apparatus for 90 minutes prior to the commencement of the session. Acquisition trials began with S being placed in the apparatus to begin the first ITI. The

ITIs during this and subsequent stages of the avoidance procedures, were either 75, 90, or 105 seconds in duration, with a mean duration of 90 seconds. Throughout the experiment, the ITIs were presented in a predetermined random order. The end of the ITI marked the onset of the white noise CS which was followed after 10 seconds by a 0.6mA shock being passed through the grid. The shock could only be terminated by S interrupting the photobeam in the adjoining chamber, thus initiating the next ITI. Both CS and US were response terminated during this phase of the procedure. A crossing response within 10 seconds of CS onset served to both terminate the CS and prevent the occurrence of shock. Intertrial responses were recorded but did not influence the duration of the ITI. Trials were always initiated by E on the side of the apparatus occupied by the subject at the end of the ITI.

Training was continued until S achieved the criterion of 5 consecutive avoidance responses. At this point of the experiment, 41 SS were rejected for either failing to achieve this criterion within 60 trials, or for failing to perform a single avoidance response within 40 trials. The remaining 30 SS were assigned to one of six experimental groups of 5 animals each. These groups received differential treatment only in the subsequent response prevention and

extinction phases of the experiment.

Response Prevention. Upon attaining the acquisition criterion, S was removed to a nearby retaining cage for 60 seconds while the shock source was disconnected and the barrier raised and latched to the ceiling of the apparatus. Two of the the experimental groups (RP(0)-E and R2(0)-NE) served as control groups for the effects of response prevention, and remained in the retaining cage throughout the treatment procedure. The remaining 4 groups were returned to one side of the apparatus to begin response prevention trials. Two of these groups, (RP(3)-E and RP(3)-NE), received three treatment trials, while the remaining two groups, (RP(9)-E and RP(9)-NE), received nine trials. Replacing S in the apparatus initiated an ITI, at the end of which, the white noise CS was introduced. The CS terminated automatically after 10 seconds, thus beginning a new trial. Throughout each CS presentation, S was allowed free movement within the compartment in which he was located, but was blocked from entering the adjoining compartment by the barrier. Response prevention trials were initiated in the compartment where S had completed acquisition training, with S being forced to remain in this compartment throughout the procedure. Following the completion of the required number of trials, S was again returned to the retaining cage for 60

seconds while the barrier was lowered in preparation for extinction training.

In order to control for any effects due to the passage of time between acquisition and extinction, all groups were matched to those receiving 9 trials of response prevention. These latter animals spent approximately 15 minutes in the treatment procedure. As those groups receiving 3 response prevention trials spent only 5 minutes in this treatment, they were kept in the retaining cage for an additional 10 minutes following acquisition before being returned to the apparatus. Groups RP(0)-E and RP(0)-NE merely remained in the retaining cage for the full 15 minutes.

Extinction. Following the response prevention procedure, Groups RP(0)-NE, RP(3)-NE and RP(9)-NE were returned to the operant chamber for fear testing. As these groups did not receive extinction training, they differed in terms of CS exposure only by the number of response prevention trials each received. The remaining three groups (RP(0)-E, RP(3)-E and RP(9)-E) were returned to the avoidance apparatus 60 seconds following response prevention to begin the first ITI of extinction training. In order to minimize the effects of possible learned freezing responses to compartmental cues other than the CS, the first extinction trial was initiated with S being returned to the

compartment opposite to that occupied during response prevention.

Extinction trials were carried out in a manner identical to that described for acquisition training with two major exceptions. Firstly, shock was never present throughout this procedure. In addition, the CS terminated automatically after 10 seconds of its onset unless S made a crossing response within this time. In the latter case, the CS was response terminated as during acquisition. Trials were continued until S failed to respond within 10 seconds on 5 consecutive trials. At this point, S was returned to the operant chamber for fear testing.

Fear Test. The procedure described here was identical for all subjects. The first 20 minutes of the session were considered as a warmup period during which response rates were allowed to stabilize. Following this, the white noise and house light stimuli were presented in a manner and sequence identical to that described for the habituation pre-test, with the exception that 4 rather than 6 presentations of each stimulus were introduced. Again, the number of bar presses were recorded for both the 20 second CS and 20 second pre-CS periods.

Results

Acquisition and Extinction. In order to determine whether all groups had received similar experience during acquisition, both the number of shock reinforced trials and the total number of trials to acquisition were recorded for each S. These data are summarized in Table 1. Analysis of variance applied to each of these measures indicated no significant effects (see Appendix A). Thus, behavioral differences in subsequent stages of the experiment are not likely to be attributable to intergroup differences during acquisition. In particular, it may be assumed that all groups received similar amounts of reinforced and nonreinforced CS exposure prior to the response prevention procedures.

The median number of trials to extinction for those groups receiving extinction training are presented in Table 1. It should be noted that a score of 5 on this measure indicates no responding during extinction. As shown in Table 1, a large proportion of Ss in both response prevention groups fell into this 'no response' category, while none of those Ss in Group RP(0)-E were so classified. A Kruskal Wallace analysis of variance by ranks showed strong intergroup differences in rate of extinction ($H = 10.67$,

TABLE 1

SUMMARY OF AVOIDANCE BEHAVIOR FOR ALL GROUPS
DURING ACQUISITION AND EXTINCTION

	RP(0)-NE (n=5)	RP(0)-E (n=5)	RP(3)-NE (n=5)	RP(3)-E (n=5)	RP(9)-NE (n=5)	RP(9)-E (n=5)
Mean trial of fifth consecutive avoidance response	33.6	30.8	35.4	36.6	35.2	36.4
Mean number of shocks received during acquisition	22.2	19.0	26.4	25.8	22.0	24.6
Median number of trials in extinction	-	13.0	-	5.25	-	5.75
Proportion of Ss not responding during extinction	-	0/5	-	4/5	-	3/5

In the name for each group, the numbers (0,3,9) refer to the number of response prevention trials received; the letters (E, NE) refer to whether extinction training was, or was not, administered following response prevention.

$p < .01$). It appears that both of Groups RP(3)-E and RP(9)-E extinguished more rapidly than Group RP(0)-E ($U = 0.00$, $p < .01$ for each comparison), while the two groups receiving response prevention trials did not differ on this measure ($U = 10.0$, NS). As extinction proceeded extremely rapidly in Group RP(3)-E, it is likely that any additional facilitation of extinction offered by 9 treatment trials was obscured by a floor effect. In any event, these data demonstrate the potency of the response prevention technique in facilitating extinction of avoidance responding (Baum, 1970).

Fear Measurement. All statistical analyses to be presented in this section were conducted after the data had been converted to a relative measure of conditioned responding (Annau and Kamin, 1961). This was achieved by dividing the number of responses during the 20 second CS by the sum of responses in the CS period and those in the 20 second period immediately preceeding CS onset (ie. CS/CS+preCS). The resulting ratio may take on values between 0 and 1 where 0 indicates no responding in the presence of the CS (complete suppression), and 1 indicates responding only in the presence of the CS (complete excitation). A value of .5 indicates equal responding during the CS and preCS intervals and suggests no conditioned effects of the CS on responding. It is those values between 0 and .5 which are generally

interpreted as evidence of fear elicited by the CS.

The mean ratios obtained during the habituation pretest session for both house light and white noise are presented in Table 2. Although each stimulus was exposed on 6 occasions during this session, only the last 4 presentations of each are included in the reported data. Pilot research had indicated that the first two presentations of each stimulus tended to disrupt responding, presumably due to their novelty in the operant environment. As can be seen in Table 2, responding tended to be fairly unaffected on trials 3-6 (grand mean, HL=.496; WN=.523), suggesting that neither stimulus was capable of eliciting suppression of responding prior to the avoidance procedures.

Following the experimental procedures, both stimuli were again presented as a test for conditioned fear. Response changes in the presence of the neutral house light were of particular interest here as a measure of suppression due to disruption in background stimulation. As can be seen in Table 2, the test ratios for the house light (grand mean=.489) were highly similar to those obtained during the pretest session ($t = .55$, $df = 29$, NS). Thus, any suppression of responding in the presence of the white noise is likely due to the associative value of that stimulus rather than to its introduction as an extraneous stimulus.

TABLE 2

CS
 MEAN ----- RATIOS DURING
 CS + PRE CS

HABITUATION PRETEST AND FEAR TEST SESSIONS FOR BOTH
 WHITE NOISE (WN) AND HOUSE LIGHT (HL) STIMULI

	RP(0) - NE (n=5)	RP(0) - E (n=5)	RP(3) - NE (n=5)	RP(3) - E (n=5)	RP(9) - NE (n=5)	RP(9) - E (n=5)	Grand Mean (N=30)
HL pretest: trials 3-6	.490	.487	.500	.467	.525	.508	.496
HL fear test: trials 1-4	.485	.495	.515	.491	.478	.470	.489
WN pretest: trials 3-6	.578	.493	.536	.500	.518	.510	.523
WN fear test: trials 1-4	.350	.490	.267	.255	.327	.227	.319
WN fear test: trial 1	.140	.501	.165	.123	.233	.199	.227

In the name for each group, the numbers (0,3,9) refer to the number of response prevention trials administered; the letters (E, NE) refer to whether extinction training was, or was not, administered following response prevention.

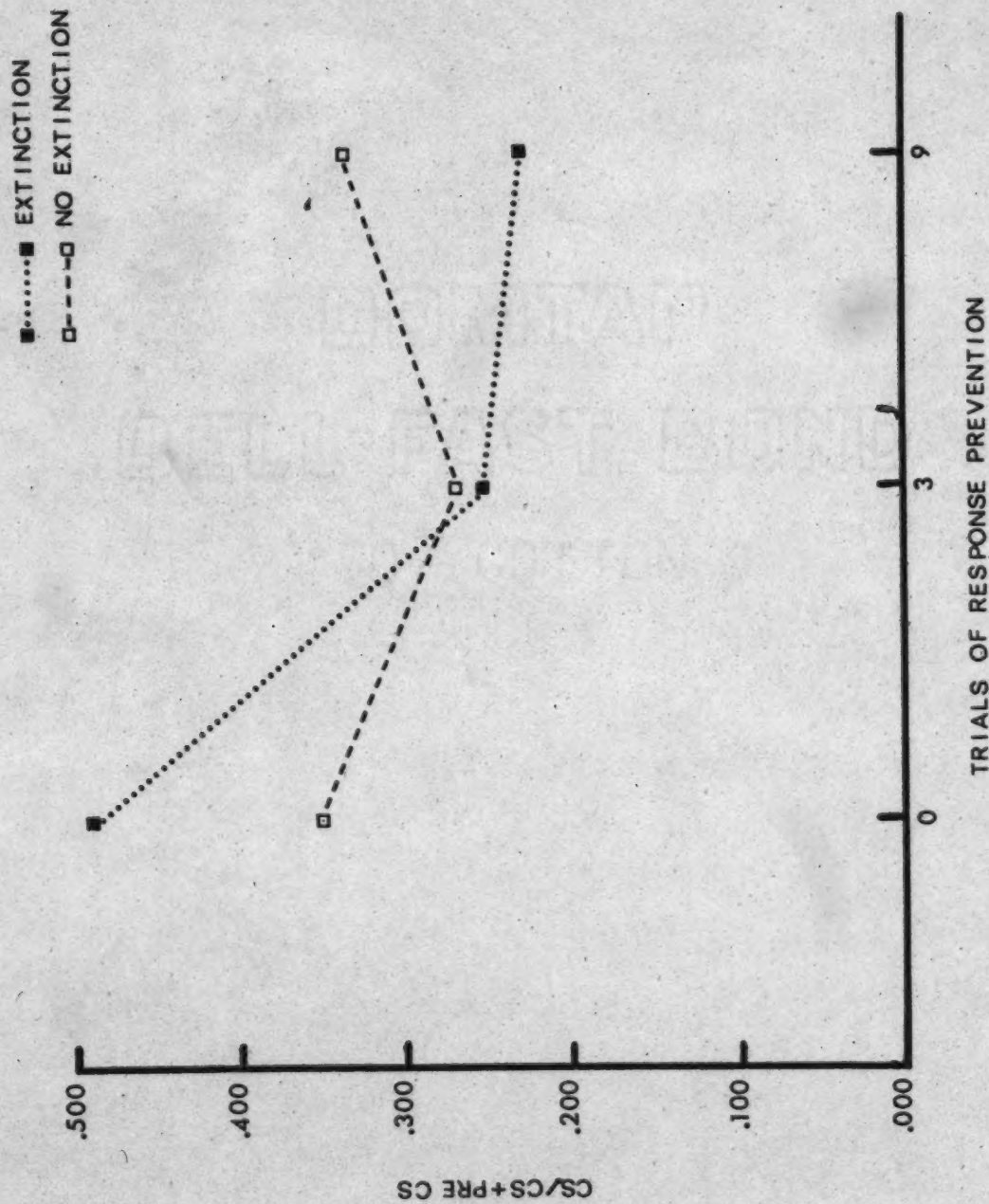


Figure 1. Mean ratios of conditioned responding in the presence of the white noise on trials 1-4 of the fear test session.

The mean ratios for trials 1-4 of the white noise are listed in Table 2 and presented graphically in Figure 1. An analysis of variance on these means revealed significant effects for both the response prevention treatment ($F=10.22$, $df=2/24$, $p<.01$), and the response prevention x extinction interaction ($F=4.87$, $df=2/24$, $p<.05$) (see also Appendix B). According to simple main effects analysis (Kirk, 1968) applied to the significant interaction, it appears that post extinction levels of fear were differentially affected by the response prevention treatment ($F=27.71$, $df=2/24$, $p<.01$), with Group RP(0)-E showing less suppression than either of Groups RP(3)-E ($t=4.27$, $df=24$, $p<.01$), or RP(9)-E ($t=4.78$, $df=24$, $p<.01$). It is worth noting here, that the mean suppression ratio for Group RP(0)-E was .490, suggesting that conditioned fear in these SS was reduced to a 'zero' level as a function of extinction training.

For those SS tested prior to the extinction procedures, response prevention did not appear to differentially affect fear ($F=2.49$, $df=2/24$, NS). Planned orthogonal comparisons revealed that Groups RP(0)-NE, RP(3)-NE and RP(9)-NE all exhibited similar levels of suppression to the white noise. Further, extinction training served to reduce these levels of suppression only for those SS not receiving a period of

response prevention prior to extinction (RP(0)-NE vs. RP(0)-E; $F = 6.48$, $df = 2/24$, $p < .01$). Subjects receiving either 3 or 9 treatment trials tended to show equal suppression whether tested immediately following response prevention or following extinction.

In order to further clarify the effects of the avoidance procedures on fear, an analysis similar to that described above was conducted on the suppression ratios obtained from the first white noise trial (see Fig. 2). Responding in the presence of this stimulus on trial one should offer the advantage of being unconfounded by adaptation to the CS due to repeated presentations in the operant environment. This analysis however, provided no information beyond that demonstrated in the data for trials 1-4.

Further consideration of the pre-test data revealed considerable intra-group variability. Subjects who scored well above .500 on the pre-test might exhibit considerable fear during the test phase and still score a fairly high suppression ratio. Analysis of the pre-test white noise ratios revealed further that such animals were differentially distributed amongst groups with S_s in Group RP(0)-NE tending to exhibit higher scores during this session. In order to correct for this difference, each S_s 's

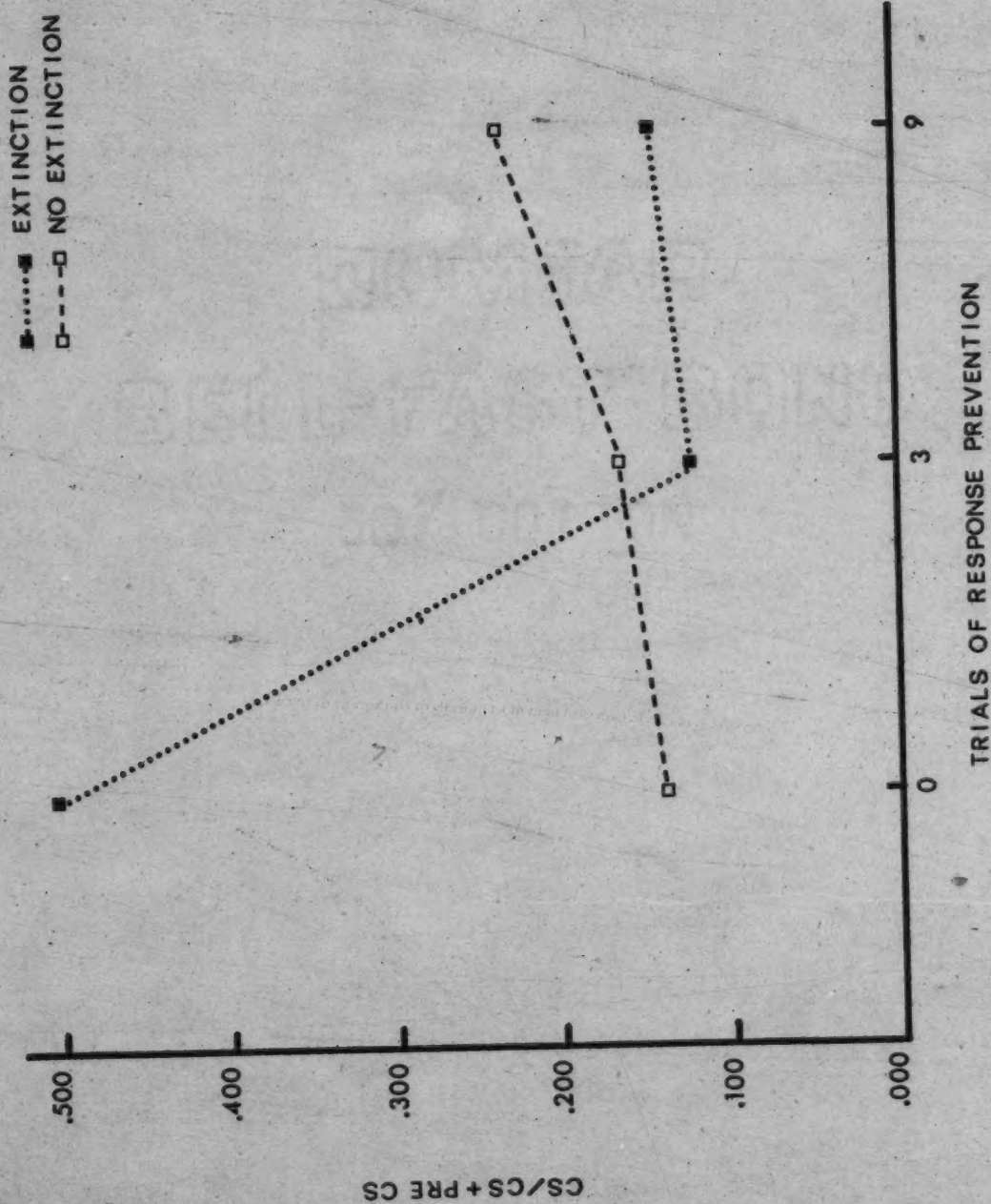


FIGURE 2. Mean ratios of conditioned responding in the presence of the white noise on Trial 1 of the fear test session.

test score was subtracted from his pre-test score. While analyses based on these adjusted data for both trials 1 and 1-4 revealed increased levels of significance on some measures, the results were again identical to those reported above for the unadjusted data on trials 1-4.

One final series of tests were designed to more directly test Shipley *et. al.*'s (1971) contention that fear in a response prevention paradigm is solely a function of total CS exposure. As the data involved in these analyses tended to be highly skewed, no assumption of normality of distributions could be made and thus, non-parametric techniques were employed.

The previous analyses have indicated that Group RP(0)-E tended to exhibit less suppression in the presence of the white noise than either of Groups RP(3)-E or RP(9)-E. If fear were reduced as a function of CS exposure, it might be expected that Group RP(0)-E would have received greater post-acquisition exposure than either of the other two groups. In order to test this hypothesis, the total amount of CS exposure both during response prevention and extinction was calculated for each S. Although Group RP(0)-E (median exposure= 108.4 sec.) did receive more exposure to the CS than Group RP(3)-E (median exposure= 80.0 sec.; $U= 0.00$, $p<.01$), total exposure did not differ between the

former group and Group RP(9)-E (median exposure= 140 sec.; $U = 5.0$, NS).

Finally, the CS exposure hypothesis would likely expect a positive correlation between total CS exposure and suppression ratios on the fear test. For this analysis, the data for all 30 subjects was considered. Basing fear test performance on the mean ratio for trials 1-4, a Spearman correlation by ranks indicated no relationship between the two measures ($r = -.05$, NS).

Discussion

The results of the present experiment seem to suggest that while response prevention tends to facilitate extinction of an instrumental avoidance response, the process which is responsible for this facilitation is not Pavlovian extinction of fear. The major impetus for this conclusion stems from post-extinction performance on the conditioned suppression fear test. While Ss in Group RP(0)-E tended to show little suppression in the presence of the avoidance CS, considerable suppression was observed in both response prevention groups despite the fact that all Ss had achieved a common criterion of extinction. This result is clearly antagonistic to the two-process theory position (Mowrer, 1947) that extinction of conditioned fear must precede, or coincide with, cessation of instrumental responding. Further, the observed differences cannot be attributed to reduced CS exposure in the response prevention groups (Shipley et. al., 1971) as Groups RP(0)-E and RP(9)-E experienced similar post-acquisition exposure to the white noise. Presumably, fear should have suffered Pavlovian extinction to an equal extent in both groups resulting in similar test performances.

The present results appear to offer some support for

competing response theory. In agreement with Page's (1955; Coulter, Riccio and Page, 1969) earlier findings, it appears from the present study that greater levels of residual fear are observed when extinction training is preceded by a period of response prevention. As previously noted, Baum's (1971) failure to observe such an effect may have been due to methodological weaknesses in the test for fear, (ie. failure to control for spontaneous recovery), or the use of a single response prevention trial of greatly extended duration (20 minutes).

Also consistent with competing response theory is the finding that fear was maintained throughout the response prevention procedure. Neither 3 nor 9 treatment trials produced any reduction in conditioned suppression over that observed following acquisition training. Again, it does not appear that CS exposure during response prevention resulted in any appreciable Pavlovian extinction of fear. Furthermore, CS exposure during extinction did not reduce fear from those levels observed following the response prevention treatment. A similar finding has also been reported by Linton et. al. (1970) using a reentry test to measure fear. The fact that "incubation" or enhancement of fear was not observed here, may simply indicate that the necessary conditions for its occurrence were not present.

Due to the vagueness of the incubation model (Eysenck, 1968), it is not clear as to what these conditions are. However, it is possible that post acquisition levels of fear were insufficiently profound to allow the fear CR to act as a noxious stimulus.

To this point, we have been following previous studies (Brimer and Kamin, 1963; Kamin et. al., 1963) in interpreting response suppression in the presence of the avoidance CS as an index of conditioned fear. In terms of the present experiment, an alternate interpretation of the data may also be offered. To reiterate, competing response theory postulates the acquisition of a new avoidance response which is motivated by fear. It is further assumed that performance of this new response obeys the laws postulated by two-process theory. That is, CS onset elicits a conditioned fear reaction which serves to motivate the avoidance response. However, as we have previously argued, the relationship between conditioned emotionality and instrumental responding appears to be considerably less correlated than two-process theory would predict (Kamin et. al., 1963). In particular, avoidance responding may persist in the absence of a fear reaction elicited by the CS (Black, 1959). Similarly in the case of a learned competing response, it may only be assumed that fear underlies and

motivates the response. Unfortunately, in the case of a competing response such as freezing, neither the reentry test (Page, 1955) nor the conditioned suppression test (Estes and Skinner, 1941) allow for direct testing of this assumption. That is, freezing in the presence of the CS would result in similar response suppression, or passive avoidance, whether freezing served as an avoidance response motivated by fear, or an instrumental response unrelated to fear. Rather than indexing an emotional reaction, the suppression data may therefore be interpreted in terms of the strength of the competing response. Despite this ambiguity, either interpretation of the present data would seem to be congruent with competing response theory predictions. That is, if suppression in the presence of the CS is interpreted as a measure of response strength, then the data suggest that response prevention does in fact lead to the acquisition of a competing response. Alternatively, as an index of fear, the suppression data confirm the competing response theory predictions that fear is maintained throughout response prevention, and that greater levels of post-extinction fear are exhibited following a response prevention treatment.

One finding of the present study which does seem to be somewhat at odds with competing response theory, is the

apparent effectiveness of only three trials of response prevention. Based on both the facilitated extinction in Group RP(3)-E, and the considerable levels of suppression exhibited by both this group and Group RP(3)-NE, it would appear that 3 treatment trials were sufficient for the acquisition of the competing response. Further, based on the completeness of elimination of the avoidance response in Group RP(3)-E, it seems possible that even fewer response prevention trials may have served to provide for the acquisition of the competing response. It seems unlikely that this limited number of trials could provide sufficient CS terminations to 'adventitiously' reinforce and stabilize a new response. In view of these data, it seems desirable at this stage to consider an alternate model to account for the processes involved in the acquisition of a competing response.

The approach to be presented here borrows from the analysis of avoidance behavior formulated by Bolles (1970). Bolles maintains that aversive stimulation rapidly restricts S's available response repertoire to a narrow class of species specific defense reactions (SSDRs). In the case of the laboratory rat, this repertoire consists of flight, freezing, and aggressive behaviors. According to this model, presentation of the US serves to punish certain of the SSDRs

while others escape punishment by allowing $\bar{S}$ to avoid the US. The emergence of an effective avoidance response is believed to necessitate the suppression of those SSDRs which have been punished.

If a learned flight response is indirectly punished by being blocked, another SSDR will rapidly be adopted while the flight response is suppressed. In a response prevention paradigm, the SSDR most likely to be adopted would be that of freezing (Baum, 1970; Bersh and Keltz, 1971). Additional response prevention trials would lead to a stabilization of the freezing response as it would never be followed by shock. When the flight response is again made available during extinction, $\bar{S}$ may fail to run as freezing has become an adequate response. This need not imply that the CS is no longer capable of eliciting fear. Rather, the competing freezing response in the presence of the CS has now become a 'safe' response.

The SSDR model is similar to that proposed by competing response theory in that both account for facilitation of extinction by means of an incompatible response. The main difference between the models lies in the means by which this new response is believed to become established. While competing response theory views this acquisition process as involving traditional mechanisms of reinforcement, (ie. fear

reduction through CS termination), the SSDR model postulates a species bound tendency to adopt an alternative response from an existing repertoire. Thus, the latter model can account for the apparently rapid acquisition of the new response. Casual observations of the subjects' behavior during response prevention revealed very rapid establishment of freezing behaviors in the present experiment. Many SS froze at CS onset and remained in this position throughout response prevention and extinction, while some SS briefly attempted to perform the learned crossing response before adopting an immobile posture.

Some support for the SSDR formulation accrues from the findings of Bersh and Keltz (1971). These authors administered response prevention trials of various durations and observed facilitated extinction under all conditions. At this point, a single shock reinforced presentation was administered while the original avoidance response was blocked. A second extinction session revealed recovery of responding in all groups. It is unlikely that a single shock, which provided no reinforcement for the original avoidance response, would have reinstated this response while rapidly eliminating a competing response reinforced during response prevention. According to the SSDR model however, the shock trial may have served to punish the

freezing SSDR, thereby increasing the probability of the previously successful flight response being reinstated.

It was suggested earlier that the nature of CS presentations might play a role in determining the effects of response prevention. Unlike most other studies employing a similar paradigm, the present experiment exposed the CS for a period equal to the CS-US interval. Unfortunately, as CS duration was not manipulated as an independent variable, no firm conclusions can be drawn as to its role in accounting for the present results. However, based on the discrepancies between the present findings and those reported by other studies (ie. Baum, 1971; Shipley *et. al.*, 1971), it appears that CS duration may indeed be a potent variable. The present data have offered no support for the notion that total CS exposure is the crucial factor influencing fear during response prevention. It might therefore be hypothesized that the distribution of total CS exposure is a factor influencing the effects of response prevention. Specifically, brief exposures may lead to undiminished fear by simulating the original avoidance contingencies, while prolonged exposures may enable a reduction in fear by either altering these contingencies (generalization decrement), or through Pavlovian extinction.

A similar conclusion has been reported in the clinical

literature on implosive therapy. The failure of some studies (ie. Rachman, 1966) to demonstrate therapeutic improvement has been attributed in part to insufficiently prolonged treatment exposures to the aversive stimuli (Morganstern, 1973). Staub (1968) has further argued that duration of continuous exposure to these stimuli may be the crucial variable determining therapeutic success. At very least, the present results have demonstrated that repeated brief CS presentations do not lead to a reduction in fear. However, if our interpretation of the data according to a SSDR model has merit, drawing parallels between the response prevention and implosive paradigms involves even more risk than is usually the case.

Most behavioral therapies claim that their techniques are derived from well established laws of learning, and controlled laboratory experiments, often using subhuman subjects (Breger and McGaugh, 1965). The response prevention paradigm is an excellent example of the latter claim (Baum, 1970). However, as Breger and McGaugh (1965) have argued, these claims may be highly misleading. The "laws of learning" referred to by these therapists are hypotheses rather than laws and in most cases, do not command universal acceptance. While two-process theory is generally accepted as the theoretical framework upon which implosive therapy

operates (Stampfl and Levis, 1968), the present results suggest that this model is inadequate to account for the effects of response prevention. Further, as has been argued in the SSDR analysis, the effects of response prevention appear to be highly determined by the experimental species employed. Thus, at a human level, the variables accounting for therapeutic success may not be those operating at the level of lower animals in a response prevention paradigm. It would appear that while the response prevention paradigm has definite implications for any theory attempting to account for avoidance behavior, its use as an experimental analogue for implosive therapy must clearly be reconsidered.

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APPENDIX A

RESULTS OF ANALYSIS OF VARIANCE APPLIED TO
AVOIDANCE ACQUISITION DATA

TABLE A-1

Analysis of number of trials to acquisition

Source	DF	MS	F
Response Prevention (A)	2	45.73	.495
Extinction (B)	1	.13	.001
A x B	2	13.33	.144
Error	24	92.35	

TABLE A-2

Analysis of number of shocks received during acquisition

Source	DF	MS	F
Response Prevention (A)	2	75.63	.495
Extinction (B)	1	1.20	.001
A x B	2	21.10	.144
Error	24	77.58	

APPENDIX B

ANALYSIS OF VARIANCE AND SIMPLE MAIN EFFECTS ANALYSIS
CS

APPLIED TO ----- RATIOS FOR
CS + PRE CS
TRIALS 1-4 (WHITE NOISE) OF FEAR TEST

TABLE B-1

Analysis of trials 1-4 of fear test

Source	DF	MS	F
Response prevention (A)	2	.077	10.22 ²
Extinction (B)	1	.001	0.09
A x B	2	.037	4.87 ¹
Error	24	.007	
A at B1	1	.019	2.49
A at B2	1	.208	27.71 ²
B at A1	2	.049	6.48 ²
B at A2	2	.001	.05
B at A3	2	.025	3.31
Error	24	.007	

¹ $p < .05$; ² $p < .01$

In the tables presented above, the letters A1, A2 and A3 stand for the 0, 3 and 9 trial response prevention conditions respectively; B1 and B2 stand for the extinction and no extinction conditions of the experiment.

APPENDIX C

ANALYSIS OF VARIANCE AND SIMPLE MAIN EFFECTS ANALYSIS
 CS
 APPLIED TO ----- RATIOS FOR
 CS + PRE CS
 TRIAL 1 (WHITE NOISE) OF FEAR TEST

TABLE C-1
 Analysis of trial 1 of fear test

Source	DF	MS	F
Response Prevention (A)	2	.078	3.50 ¹
Extinction (B)	1	.068	3.04
A x B	2	.133	5.94 ²
Error	24	.022	
A at B1	1	.023	1.05
A at B2	1	.186	8.45 ²
B at A1	2	.328	14.64 ²
B at A2	2	.004	.17
B at A3	2	.003	.13
Error	24	.022	

¹ $p < .05$; ² $p < .01$

In the tables presented above, the letters A1, A2 and A3 stand for the 0, 3 and 9 trial response prevention conditions respectively; B1 and B2 stand for the extinction and no extinction conditions of the experiment.

APPENDIX D

RESULTS OF ANALYSIS OF VARIANCE APPLIED TO
CS
ADJUSTED ----- RATIOS
CS + PRE CS
FOR TRIALS 1-4 OF FEAR TEST

TABLE D-1

Mean adjusted ratios for trials 1-4

RP(0)-NE	RP(0)-E	RP(3)-NE	RP(3)-E	RP(9)-NE	RP(9)-E
.228	.003	.270	.246	.191	.282

In Table D-1, greater positive values indicate greater relative suppression during fear testing.

TABLE D-2

Analysis of variance data (adjusted ratios) for trials 1-4

Source	DF	MS	F
Response Prevention (A)	2	.059	10.11 ²
Extinction (B)	1	.021	3.54
A x B	2	.064	11.01 ²
Error	24	.006	

² p<.01

APPENDIX E

RESULTS OF ANALYSIS OF VARIANCE APPLIED TO
CS
ADJUSTED ----- RATIOS
CS + PRE CS
FOR TRIAL 1 OF FEAR TEST

TABLE E-1

Mean adjusted ratios for trial 1

RP(0) -NE	RP(0) -E	RP(3) -NE	RP(3) -E	RP(9) -NE	RP(9) -E
.438	-.009	.371	.377	.284	.310

In Table E-1, greater positive values indicate greater relative suppression during fear testing

TABLE E-2

Analysis of variance data (adjusted ratios) for trial 1

Source	DF	MS	F
Response Prevention (A)	2	.063	3.05
Extinction (B)	1	.143	6.91 ¹
A x B	2	.179	8.62 ²
Error	24	.021	

¹ $p < .05$; ² $p < .01$